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The Impact of Digital Infrastructure and AI Readiness on SME Dynamism

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Abstract

This study examined the impact of digital infrastructure and AI readiness on SME dynamism across 153 countries during 2010–2022. Using secondary panel data from the World Bank World Development Indicators, the study constructed a complete-case dataset of 1,571 country-year observations. SME dynamism was measured through new business density, while digital infrastructure was represented through fixed broadband subscriptions and secure internet servers. AI readiness was measured through a proxy index based on secure internet servers and ICT goods exports. GDP growth and inflation were included as macroeconomic control variables. The analysis used descriptive statistics, annual mean trends, correlation and VIF diagnostics, pooled OLS, country fixed-effects regression, two-way fixed-effects regression, and robustness specifications. The descriptive results showed that SME dynamism and digital infrastructure generally increased during the study period. The correlation analysis showed a strong positive association between digital infrastructure and SME dynamism, while AI readiness had a weaker positive association. However, the regression results became more cautious after controlling for country and year effects. Digital infrastructure was positive and significant in pooled OLS and country fixed-effects models but became statistically insignificant in the two-way fixed-effects model. The AI readiness proxy remained insignificant across the main and robustness models. GDP growth showed a more consistent positive relationship with SME dynamism. The findings suggest that digital infrastructure and AI readiness may provide enabling conditions for SME activity, but they are not sufficient alone to explain SME dynamism across countries. Broader economic, institutional, and contextual conditions remain important in shaping entrepreneurial activity.

Keywords: *SME dynamism, digital infrastructure, AI readiness, new business density, panel data, fixed effects, digital transformation*

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1. INTRODUCTION

Small and medium-sized enterprises remain important contributors to entrepreneurship, employment creation, innovation, and economic renewal, but their ability to remain active and competitive is now increasingly connected with the digital environment in which they operate. Digital transformation has been a topic of discussion as a source of innovation in SMEs particularly since it can transform the business process, market access, and value creation (Gao et al., 2026). The use of digital technology has also been empirically associated with SME performance, as digital transactions have been found to positively favor firms to leverage digital technologies in production, communication, customer access and operational improvement (Utonga et al., 2026). At the macro level of technology, industrial internet and digital pathways have been found to enhance the performance and competitiveness of SMEs via technological, organizational and environmental dimensions (Wang et al., 2024). Taking this into account, the results of these studies indicate that digital infrastructure cannot solely be considered as a technical background condition but rather as a enabling base that can trigger SME activity to be more connected, responsive and competitive.

Meanwhile, AI readiness has emerged as a significant component of the SME digital transformation discourse. AI adoption in SMEs has been examined via technological, organizational, and environmental dimensions, revealing that elements such as readiness, perceived usefulness, organizational capability, and implementation challenges are influencing the adoption of AI (Delgado-Sánchez et al., 2025). Based on studies regarding the intention to adopt AI in SMEs, it has been identified that a SME's intention to adopt AI is related to certain readiness conditions instead of merely being a matter of technological availability (Apostoaie et al., 2025). Moreover, AI change readiness is also associated with SME performance in parallel with both digital leadership and big data analytical capability (Aftab et al., 2025). But most of this literature is at the firm level, survey based or sector specific. Thus, to expand the discussion, this study uses a cross-country panel data set covering 153 countries for the period 2010-2022 and a total of 1,571 country-year observations. The level of SME dynamism is indicated by the density of new businesses, Digital infrastructure is identified by fixed broadband subscriptions and secure internet servers, and AI readiness is estimated using a proxy index, derived from secure servers and ICT goods exports. Panel regression models are employed to determine the robustness of the relationship between digital infrastructure and AI readiness with SME dynamism, accounting for differences in countries and in the different years.

The main objective of this study is to examine how digital infrastructure and AI readiness influence SME dynamism across countries during 2010–2022, while controlling for macroeconomic conditions and country- and year-specific effects.

1.1 Research Questions

1. What are the main descriptive patterns and annual trends in SME dynamism, digital infrastructure, and AI readiness across countries during 2010–2022?
2. How are digital infrastructure and AI readiness associated with SME dynamism in the cross-country panel dataset?
3. Do digital infrastructure and AI readiness continue to explain SME dynamism after controlling for country-specific effects, year-specific effects, GDP growth, and inflation?

2. LITERATURE REVIEW

The existing literature generally agrees that digital transformation has become an important condition for SME competitiveness, but it does not treat digital transformation in a uniform way. Gao et al. (2026) conducted a literature review on digital transformation and innovation in the context of SMEs and identified digitalisation as a general process associated with SMEs' innovation capacity and future business development. While this perspective can help, it continues to be primarily about the internal changes of SMEs, instead of the impact of national digital conditions on firm formation across economies. Digital change impacts production and organizational practices, as was argued by Roblek et al. (2021) who characterized digital transformation in small and medium manufacturing enterprises as a disruptive innovation. However, SME dynamism is also influenced by broader infrastructure, market access, regulation, and macroeconomic conditions

which makes it difficult to identify the pure effects of manufacturing through manufacturing-based studies. The findings from Utonga et al. (2026) from Tanzania fruit juice processing SMEs showed that digital technology can enhance SMEs performance in the sector; however, the study is sector-specific, limiting its generalizability. Similarly, Wang et al. (2024) researched the relationship between industrial internet pathways and the competitiveness and performance of SMEs, with a more firm/industry-focused perspective. While they help to confirm the relevance of digitalisation, they fail to answer whether digital infrastructure at the level of the country is sufficient to account for dynamism at the SME level over time.

The second stream has progressed from the domain of digital transformation to the areas of digital capabilities and implementation of Industry 4.0, analytics; however, there are limitations to this literature, too. The current study found data capability to be a key component of SME competitiveness by creating a big data analytics capability ecosystem model for SMEs by Falahat et al. (2022). However, these models tend to take for granted the fact that firms are already working in a digital context, where there are existing data systems, connectivity and technical capacities. Justy et al. (2023) investigated drivers and barriers to the implementation of data analytics in SMEs, which is valuable as it indicates that even if a digital technology is available, it is not necessarily implemented. Marrucci et al. (2023) have analyzed Industry 4.0 implementation pathways in manufacturing SMEs and demonstrated that technological change is dependent on a combination of organizational and contextual arrangements. Da Silva et al. (2025) also make the link between digital technologies and competitiveness of manufacturing SMEs, although the evidence is again strongest at the firm or sector level. Perhaps the weakness in this literature is that it fails to mention digital capability rather than ignore the concept, but it rarely links digital capability to the macro level indicators, like broadband subscription base, secure internet servers, and export capability for ICT products. Consequently, literature provides evidence of how SME may leverage digital technology, but not so much on the relationship between digital infrastructure and formation of SMEs by the countries.

Another layer exists on the literature of AI adoption in SMEs, and there is a measurement problem of significance there. Using the TOE–DOI framework, which refers to the influence of technological, organizational and environmental factors in adoption, Delgado-Sánchez et al. (2025) examined AI adoption in SMEs. Apostoaie et al. (2025) explored the intention to adopt AI in Romanian SMEs, revealing that AI uptake is a function of the readiness-related conditions, not technology exposure. In the context of Italian SMEs, Aftab et al. (2025) established a relationship between AI change readiness and SME performance, mainly related to digital leadership and big data analytical capacities. Issa et al. (2022) also introduced the idea of an AI-readiness and adoption framework for AgriTech companies, indicating that in order for AI to be adopted, it needs to be first ready. These studies are beneficial as they take into account the adoption of AI as a process, not a decision. However, they mainly rely on sectoral, single country samples or surveys. One caveat is that AI readiness is typically assessed via perceptions, managerial capability, or organisation readiness, with macro level, readiness being more challenging to measure. This opens the door to reanalysis of existing data at the national level that can provide conservative measures of AI-readiness and analyze if proxy measures of AI-readiness and SME dynamism are linked.

AI, resilience and sustainable performance studies further extend the discussion but also often take for granted the positive impact of AI adoption on business. Taherizadeh and Beaudry (2023) shared the viewpoints of Canadian SMEs regarding AI-enabled digital transformation, revealing that digital transformation is an even broader organizational transformation process experienced through the lens of AI. Dey et al. (2023) have related AI with supply chain resilience of manufacturing SMEs in Vietnam and Shore et al. (2024) have investigated the association between entrepreneurial resilience and the use of generative AI in crisis. Chaudhuri et al. (2022) linked AI dynamism and SME innovation and sustainability, while Yesuf and Fields (2025) conducted a review on the adoption of AI as a tool to enhance SME innovation and competitiveness. Although these studies provide insights into the relevance of AI for SME performance, they are not fully testing if ‘AI-readiness' conditions result in greater SME dynamism when controlling for country-level differences and time. This is an important issue because a positive relationship observed across firms or countries may weaken once fixed national characteristics and global time shocks are taken into account. The present study therefore extends the literature by shifting the focus from adoption intention and firm-level performance to a cross-

country panel analysis of SME dynamism, using digital infrastructure and AI-readiness proxy indicators alongside GDP growth and inflation controls.

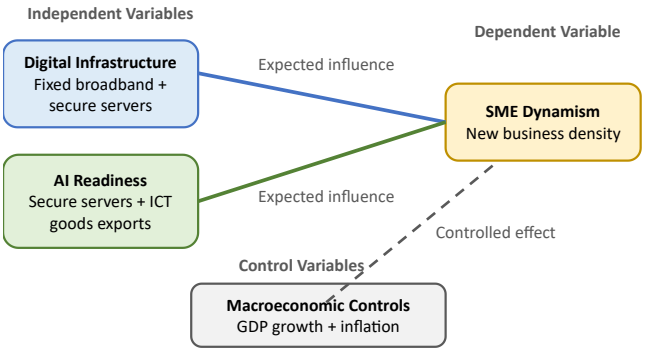

Figure 1: Conceptual Framework of the Study

2.1 Research Gap

Existing studies have mainly examined digital transformation and AI adoption in SMEs through firm-level, sector-specific, or single-country designs, focusing on adoption intention, organizational readiness, digital leadership, analytics capability, competitiveness, resilience, and performance (Aftab et al., 2025; Apostoaie et al., 2025; Delgado-Sánchez et al., 2025; Gao et al., 2026; Wang et al., 2024). While these studies explain how SMEs adopt and use digital and AI-related technologies, they give limited macro-level evidence on whether country-level digital infrastructure and AI-readiness conditions are associated with SME dynamism across countries over time. This gap is important because SME creation may depend not only on internal firm capability but also on broader national conditions such as broadband access, secure internet infrastructure, ICT capacity, GDP growth, and inflation. Therefore, the present study addresses this gap by using a cross-country panel dataset from 2010 to 2022 to examine whether digital infrastructure and AI readiness explain SME dynamism after controlling for country-specific and year-specific effects.

3. METHODOLOGY

This study used a quantitative research design based on secondary panel data to examine the impact of digital infrastructure and AI readiness on SME dynamism across countries. The use of panel data was considered suitable because the study did not focus on one country or one year only; instead, it examined repeated observations across different countries over time. The analysis covered the period from 2010 to 2022. This period was selected because the dependent variable, new business density, had usable country-level coverage within these years, while later years did not provide sufficient complete values for reliable analysis. The study therefore used a cross-country panel structure to observe whether changes in digital infrastructure and AI-readiness conditions were associated with changes in SME dynamism.

The data were collected from World Bank World Development Indicators. Initially, the dataset contained 217 country entries after excluding World Bank regional, income-group, and other aggregate classifications. Since the study period covered 13 years from 2010 to 2022, the theoretical panel contained 2,821 country-year observations. After data cleaning and within-country interpolation, the final complete-case dataset included 1,571 country-year observations from 153 countries. The final dataset was unbalanced because all countries did not report complete values for every variable in every year. However, this structure was retained because unbalanced panel data are common in cross-country macroeconomic analysis, especially when several development and technology indicators are used together.

SME dynamism was measured through new business density, which represented newly registered businesses per 1,000 people aged 15–64. For the main regression analysis, this variable was transformed into a natural log form by using log of one plus new business density. This transformation was applied to reduce skewness and make the dependent variable more suitable for regression analysis. Digital infrastructure was measured through fixed broadband subscriptions per 100 people and secure internet servers per million people. These indicators were also used to construct a digital infrastructure index through min-max scaling. The index was calculated as the average of the scaled broadband and secure server indicators. AI readiness was measured through a proxy index because a direct AI-readiness indicator was not available in the World Bank dataset. The AI-readiness proxy index was constructed by combining scaled secure internet servers and ICT goods exports as a percentage of total goods exports. GDP growth and inflation were included as control variables because macroeconomic conditions could influence SME creation independently of digital infrastructure and AI readiness.

Before analysis, the dataset was cleaned and reshaped into country-year panel format. Missing values were

examined for all variables. Linear interpolation was applied only within each country, and only between available values. No leading or trailing extrapolation was used, which means that missing values before the first available observation or after the last available observation for a country were not artificially filled. Before interpolation, there were 1,512 complete observations. After interpolation, the complete-case dataset increased to 1,571 observations. In the final regression file, 1,512 rows had no imputed values, while only 62 variable-cells were interpolated, representing 0.66% of the total variable-cells used in the regression dataset. This limited use of interpolation helped retain valid observations without making the dataset artificially complete.

The analysis was conducted in several stages. First, descriptive statistics were calculated to examine the mean, standard deviation, minimum, maximum, and number of observations for each variable. Second, annual mean trends were calculated from 2010 to 2022 to observe how SME dynamism, digital infrastructure, AI readiness, GDP growth, and inflation changed over time. Third, Pearson correlation analysis was used to examine the initial association among the main variables. Variance inflation factor and tolerance values were also calculated to check multicollinearity among the predictors. This diagnostic step was necessary because highly correlated predictors could distort regression estimates.

The main inferential analysis was carried out through panel regression models. A pooled ordinary least squares model was first estimated as a baseline model. After that, a country fixed-effects model was estimated to control for unobserved country-specific characteristics that did not change over time. Finally, a two-way fixed-effects model was estimated by including both country and year fixed effects. The two-way fixed-effects model was treated as the main model because it controlled for country-level unobserved differences as well as year-specific shocks that could affect all countries in a given year. Country-clustered standard errors were used to make the regression estimates more reliable in the presence of within-country correlation over time.

Robustness analysis was also performed to check whether the results remained stable under alternative specifications. One model used the raw new business density variable as the dependent variable instead of the log-transformed version. Another model used log-transformed component variables instead of the constructed digital infrastructure and AI-readiness indices. A lagged model was also estimated to examine whether previous-year digital infrastructure and AI-readiness conditions influenced later SME dynamism. These additional models were used to determine if a sensitivity of the results to the model form or to the measurement selected was present.

The general regression model employed in the study was the following: SME dynamism was regressed on digital infrastructure, AI readiness, GDP growth and inflation. Fixed-effects specifications included country and year effects to account for country-specific characteristics and year-specific influences. This study investigated whether the role of digital infrastructure and AI readiness in explaining SME dynamism is evident not only because of cross-country differences, but also because of the inclusion of stricter panel-data controls.

4. FINDINGS OF THE STUDY

This section discusses the empirical results of the study drawn from the final complete case panel data of 1,571 country-year observations of 153 countries within 2010–2022.

Table 1: Descriptive Statistics

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Log SME dynamism	1,571	1.223498	0.793045	0.018359	3.520072
New business density	1,571	3.794050	4.728077	0.018529	32.786845
Fixed broadband per 100	1,571	15.545249	13.702472	0.001191	62.214665
Secure servers per million	1,571	8355.829734	27811.602778	0.000000	342412.963427
ICT goods exports %	1,571	4.441398	8.588291	0.000000	62.470000
GDP growth %	1,571	2.953313	4.483749	-36.391977	43.479652
Inflation %	1,571	4.533961	16.339174	-4.294873	557.201817
Digital infrastructure index	1,571	0.103890	0.092144	0.000008	0.411187
AI readiness proxy index	1,571	0.036829	0.069389	0.000000	0.519449

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The descriptive statistics indicate that there were 1571 observations in the final data set for each of the study variables, and therefore the regression sample was consistent throughout the analysis. New business density in the 30 countries had a relatively high standard deviation of 4.73, with a mean value of 3.79, indicating that dynamism of SMEs differed significantly across countries. The log transformed value of SME dynamism was 1.22 and was used to dampen the impact of extreme variation in the original business density variable. Digital infrastructure also varied significantly between countries; with an average of 15.55 fixed broadband subscriptions per 100 inhabitants and the number of secure Internet servers had an even larger difference in average (8,355.83) and a very high standard deviation (27,811.60). ICT goods exports also differed by country with an average of 4.44 per cent. Mean scores for the digital infrastructure index and AI readiness proxy index were relatively low, at 0.104 and 0.037 respectively, indicating that the overall digital and AI-readiness conditions in the countries sample remained low. Total GDP growth averaged 2.95 percent and inflation averaged 4.53 percent, but these statistics show a very wide range on the individual values, suggesting that there were countries with very different macroeconomic conditions in 2010–2022.

Table 2: Annual Mean Trends, 2010–2022

Year	N	Log SME dynamism	New business density	Digital infrastructure index	AI readiness proxy index	GDP growth %	Inflation %
2010	113	1.100988	3.172949	0.075571	0.037049	3.865348	3.867333
2011	120	1.089760	3.147310	0.078634	0.035328	3.880478	5.816833
2012	121	1.120632	3.304933	0.084338	0.034997	2.879518	4.659131
2013	131	1.138328	3.388886	0.085271	0.033683	3.056349	3.436025
2014	134	1.138974	3.453327	0.087126	0.033607	3.401532	3.139387
2015	136	1.154737	3.527508	0.092071	0.035075	3.280393	2.832984
2016	139	1.196393	3.726736	0.096368	0.035049	3.274132	3.198188
2017	138	1.231387	3.814833	0.106153	0.034326	3.503869	3.535000
2018	137	1.259564	3.984450	0.109314	0.033842	3.624726	3.501794
2019	127	1.333635	4.164105	0.120836	0.036828	2.930404	4.951549
2020	121	1.292170	3.976060	0.129082	0.041263	-4.749744	7.291786
2021	89	1.460819	5.047487	0.155440	0.047283	6.591384	5.197414
2022	65	1.661852	5.975396	0.182213	0.052126	4.110301	12.032906

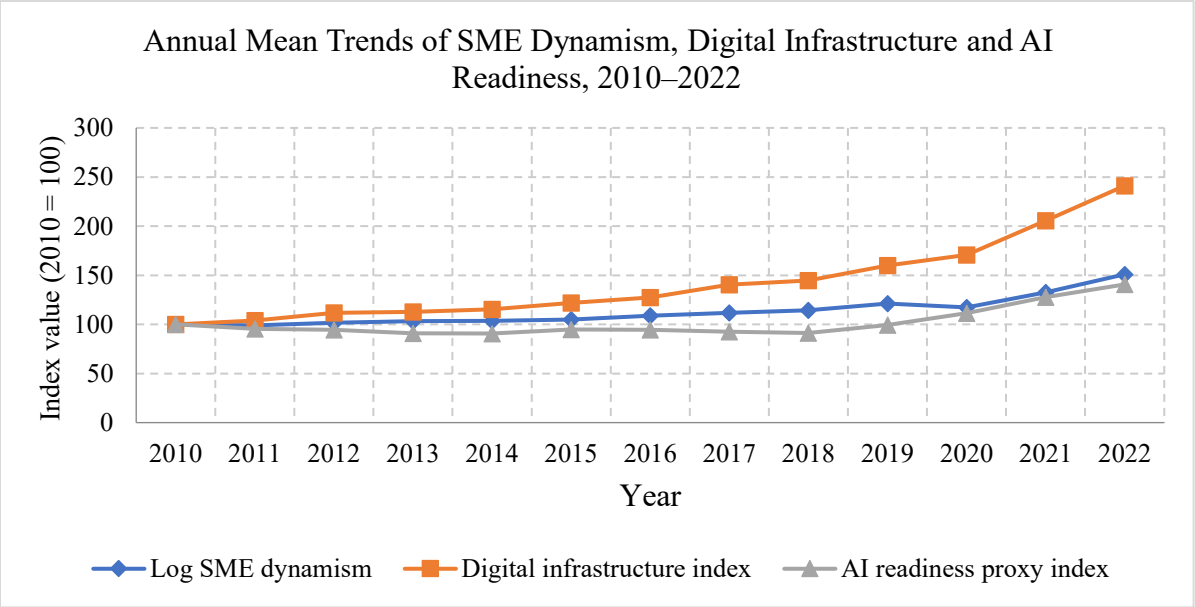

Figure 2: Annual Mean Trends of SME Dynamism, Digital Infrastructure and AI Readiness, 2010–2022

The annual mean trends show a gradual increase in SME dynamism and digital infrastructure over the study period, although the pattern was not completely smooth. New business density also improved from 3.17 in 2010 to 5.98 in 2022, while also log SME dynamism positive, from 1.10 in 2010 to 1.66 in 2022, indicating in general that business formation increased in the sample countries. Digital infrastructure index trended more clearly upwards, progressing from 0.076 in 2010 to 0.182 in 2022, reflecting steady gains in the areas of broadband and secure internet. The AI readiness proxy index was also relatively low during the period but also has experienced improvement since 2018, moving from 0.034 in 2018 to 0.052 in 2022. For GDP growth, the mean was more volatile, particularly in 2020, when it dropped to -4.75 per cent, probably due to the economic turmoil in the world during the COVID-19 period. GDP growth in 2021 rose significantly to 6.59 percent and dynamism of the SME sector also rose. Meanwhile, inflation remained volatile during the period and peaked at a mean of 12.03 percent in 2022. On balance, the table indicates that over time both digital infrastructure and the dynamism of SMEs have improved, whereas macro-economic conditions varied across countries.

Table 3: Correlation Matrix and VIF Diagnostics

Variable	LNSME	DIGI	AIRI	GDPG	INFL	Tolerance	VIF
LNSME	1.000000	0.634194	0.264135	-0.078548	-0.053816		
DIGI	0.634194	1.000000	0.295975	-0.155624	-0.086677	0.878456	1.138361
AIRI	0.264135	0.295975	1.000000	0.037432	-0.060978	0.904391	1.105717
GDPG	-0.078548	-0.155624	0.037432	1.000000	-0.057969	0.963444	1.037943
INFL	-0.053816	-0.086677	-0.060978	-0.057969	1.000000	0.986312	1.013878

Note: LNSME = log SME dynamism; DIGI = digital infrastructure index; AIRI = AI readiness proxy index; GDPG = GDP growth; INFL = inflation.

The correlation and VIF results show that digital infrastructure had the strongest positive association with SME dynamism, as the correlation between DIGI and LNSME was 0.634. This indicates that, in the sample, countries with better digital infrastructure were more likely to have higher dynamism of their SMEs. Similarly, the positive association of AI readiness with SME dynamism was observed and found to be weak with the correlation value of 0.264. GDP growth and inflation had weak negative correlation figures with SME dynamism of -0.079 and -0.054 respectively (implying minimal simple bivariate relationship with SME dynamism). VIFs were extremely small with all values between 1.014 and 1.138 and tolerance values were relatively high and not of concern. This indicates that multicollinearity was not a serious problem with the regression model and that the predictors were relatively free from distortion in the estimates when they were introduced together into the model.

Table 4: Panel Regression Results: Baseline and Fixed Effects Models

Dependent variable: **Log SME dynamism**

Variable	Pooled OLS β	SE	p-value	Country FE β	SE	p-value	Two-way FE β	SE	p-value
Constant	0.632771	0.073547	<0.000001	0.191880	0.001574	<0.000001	-0.045506	0.048064	0.345252
Digital infrastructure index	5.270122	0.600031	<0.000001	2.635377	0.456996	<0.000001	-0.082825	0.737086	0.910679
AI readiness proxy index	0.945056	0.922639	0.307323	-0.525117	0.598165	0.381394	-0.748933	0.626814	0.234016
GDP growth	0.002467	0.004229	0.560548	0.004826	0.001289	0.000256	0.005633	0.001644	0.000784
Inflation	0.000248	0.001100	0.821941	0.001108	0.000146	<0.000001	0.000889	0.000170	<0.000001
Country fixed effects	No			Yes			Yes		
Year fixed effects	No			No			Yes		
Observations	1,571			1,571			1,571		
Countries	153			153			153		

R-squared	0.408809	0.950317	0.956088
Adjusted R-squared	0.407299	0.944836	0.950826

Note: Standard errors are country-clustered. The two-way fixed-effects model controls for both country-specific and year-specific effects.

The regression results show that the relationship between digital infrastructure, AI readiness, and SME dynamism changed across model specifications. The pooled OLS model shows positive and statistically significant value for the digital infrastructure index, suggesting that countries with better digital infrastructure had higher SME dynamism in the absence of country and year fixed effects. This positive effect remained significant in the country fixed-effects model, but the coefficient fell from 5.270 to 2.635, which means that part of the initial association was explained by the fact that countries differ. But controlling for common year effects as well as country fixed effects, the coefficient of digital infrastructure turned negative and statistically insignificant, indicating that digital infrastructure had no independent impact on within-country changes in SME dynamism. The AI readiness proxy index was statistically insignificant in all three models, indicating that the AI-readiness proxy could not have a stable direct impact on SME dynamism in this data. In the fixed-effects models, GDP growth also became positive and significant, and inflation also was found to have a positive significant coefficient. Overall, the results suggest that digital infrastructure was strongly associated with SME dynamism, although two-way FE estimation produced a weaker association with macroeconomic controls that were consistently more significant.

Table 5: Robustness Analysis Using Alternative Specifications

Variable	Raw DV two-way FE β	SE	p-value	Log-component two-way FE β	SE	p-value	Lagged two-way FE β	SE	p-value
Constant	-0.882008	0.313219	0.005509	-0.040019	0.043923	0.363673	0.704336	0.032114	<0.000001
Digital infrastructure index	2.667758	4.947174	0.590504						
AI readiness proxy index	-10.790497	7.307651	0.141851						
Fixed broadband, ln				0.004905	0.059544	0.934460			
Secure servers, ln				0.000529	0.018577	0.977310			
ICT goods exports, ln				-0.022297	0.028597	0.436780			
Lagged digital infrastructure index							-0.299142	0.809219	0.712162
Lagged AI readiness proxy index							-0.503733	0.610675	0.410777
GDP growth	0.033213	0.011417	0.004167	0.005683	0.001671	0.000860	0.005896	0.001677	0.000583
Inflation	0.003061	0.000950	0.001553	0.000911	0.000171	<0.000001	0.000872	0.000146	<0.000001
Country fixed effects	Yes			Yes			Yes		
Year fixed effects	Yes			Yes			Yes		
Observations	1,571			1,571			1,418		
Countries	153			153			148		
R-squared	0.924498			0.955912			0.962315		
Adjusted R-squared	0.915450			0.950593			0.957450		

The robustness analysis confirms that the main findings were not stable across alternative specifications. The result of using new business density in its raw form as the dependent variable was a positive but statistically nonsignificant digital infrastructure index, and a negative but statistically nonsignificant AI readiness proxy. This indicates that weak effects observed for the main predictors were not only because of the log transformation of SME dynamism. For the log-component model, the estimates of the individual components (fixed broadband, secure servers and ICT goods exports) were also statistically insignificant, indicating that none of the individual components explained SME dynamism in the two-way fixed-effects model. A similar pattern was found for the lagged model, where both the lagged digital infrastructure and lagged AI readiness were negative but not significant. Positive and statistically significant GDP growth was found in all models of robustness and positive and statistically significant inflation was found as well. In sum, the results of the robustness tests indicate that, while the effects of digital infrastructure and AI readiness are descriptively and at a correlation level relevant to SME dynamism, they did not have a consistent independent effect on SME dynamism when accounted for country effects, year effects, and alternative model forms.

5. DISCUSSION

The results indicate that the aforementioned factors generally increased over the sample period; however, their correlation varied when panel controls were tightened. Descriptively, new business density expanded from 3.17 in 2010 to 5.98 in 2022 and the digital infrastructure index grew from 0.076 to 0.182 for the same period. This upward trend is consistent with the overall narrative in the literature that the presence of digital transformation and its relationship with SME activity and innovation is increasing as time goes on. To conclude the discussion, Gao et al. (2026) proposed a close relationship between digital transformation and innovation in SMEs; the increased trend of dynamism in SMEs within this study seems to support this general direction. Likewise, Utonga et al. (2026) revealed that digital technology adoption was relevant in the Tanzanian fruit juice processing industry to SMEs' performances. The current study, however, takes into account the interplay between digital conditions and dynamism of SMEs at the macro-panel level, and reveals that over time countries with improving digital conditions tended to also demonstrate an improvement in SME dynamism. This is not a direct causal proof at a descriptive level but useful initial evidence to support the view that digital conditions are important for the development of SMEs.

The correlation results also indicate a positive relationship between digital infrastructure and SME dynamism. In the other positive signs of correlation, log SME dynamism was strongly positively related to the digital infrastructure index, indicating that the countries that had more broadband and secure server infrastructure tended to have higher scores on SME dynamism. This finding confirms research by Wang et al. (2024), who demonstrated that industrial internet pathways integrated with technological, organizational, and environmental aspects can positively impact the competitiveness and performance of SMEs. This aligns with da Silva et al. (2025), which demonstrated that digital technologies in the manufacturing SMEs can help improve their competitiveness. However, care must be used in interpreting the correlation result as it reflects association but not a controlled effect. Nations that have more advanced infrastructures may feature more robust institutions, more effective regulatory framework, higher income levels and overall more advanced entrepreneurial ecosystems. As a result, the positive correlation is significant although it cannot be interpreted as evidence that digital infrastructure is sufficient to boost the dynamism of SMEs.

The regression results present a more critical view. Digital infrastructure had a positive and statistically significant impact on log SME dynamism in the pooled OLS model (beta = 5.270 with p value < 0.000001) and the country fixed-effects model (beta = 2.635 with p value < 0.000001). These findings first lend weight to the argument that the digital infrastructure is associated with greater SME dynamism. Once year fixed effects are included, however, it is negative and statistically insignificant in the 2-way fixed-effects model ($\beta = -0.083$, $p = 0.911$). The implication of this change is that the earlier beneficial association may not have been as much of a within-country effect as a cross-country difference and common response to trends in time. This is partly a rejection of the more extravagant conclusions drawn in studies that directly link the adoption of digital technology to the performance of SMEs. Indeed, while, for instance, Roblek et al. (2021) found that the digital transformation of small and medium manufacturing

firms represented a disruptive innovation, the results in the current paper indicate that this does not necessarily equate with quantifiable country-level SME dynamism when wider panel controls are included.

The AI readiness results were even more conservative. Log SME dynamism had only a weak positive correlation (r = 0.264) with the AI readiness proxy index, and for pooled OLS and country fixed-effects and two-way fixed-effects models, this relation was not significant. The coefficient was negative and not significant in the two-way main (β = -0.749 p = 0.234). While this does not contradict the relevance of AI for SMEs, it indicates that the available macro-level AI readiness proxy does not per se explain SME dynamism in this data sample. The study's result contrasts with the findings of Aftab et al. (2025), which correlated AI change readiness and SME performance in Italian SMEs and Delgado-Sánchez et al. (2025), which highlighted technological, organizational, and environmental aspects of AI adoption in SMEs. Perhaps it is because those studies have focused more closely at the firm level where leadership, skills, culture and managerial intention can be directly measured. Conversely, in this study, the authors created a proxy for AI readiness by using secure servers and ICT goods exports as a measure of a nation's digital capacity, which fails to fully capture firm-level AI awareness or skills, investments, or the adoption and use of AI. Additionally, Apostoaie et al., (2025) demonstrated that the intention to adopt AI relies on particular readiness circumstances, as national infrastructure is too generic to mirror the actual AI adoption journey within SMEs.

The robustness analysis corroborates this cautious interpretation. Using raw new business density as the dependent variable, the same pattern was observed as digital infrastructure was not statistically significant (β = 2.668, p = 0.591) and AI readiness was not statistically significant either (β = -10.790, p = 0.142). The other variables in the log-component model were also statistically insignificant, as were the lagged two-way fixed-effects model for lagged digital infrastructure (β = -0.299, p = 0.712) and lagged AI readiness (β = -0.504, p = 0.411). These results indicate that the overall findings did not unexpenseably result from the use of index variables or log transformation. They further demonstrate that digital infrastructure and AI readiness might require other complementary aspects to affect SME dynamism. This is in line with Justy et al., (2023) who demonstrated that the use of data analytics in SMEs is both a push and a pull effect and with Marrucci et al., (2023) who found that the implementation of Industry 4.0 depends on a combination of technological and organizational characteristics. In this context, infrastructure can be needed but it is not enough.

The control variables yielded results that were also interesting but complex. Both the two-way fixed-effects model (β = 0.0056, p = 0.000784) and the robustness models showed positive and statistically significant results for GDP growth, but not for the digital and AI-readiness indicators. This is in theory valid, as the generation of companies tends to react to the general economic growth, the demand for them and the investor confidence. The coefficient of inflation, however, was positive and significant in the fixed-effects models, including the main two-way fixed-effects model (β = 0.0009, p < 0.000001), which is not the result that would be expected if inflation is interpreted as merely macro-economic instability. This is not a massively large set of results. It could be an effect of the mixed structure of the cross-country sample, as inflation may occur in the context of post-crisis recovery, an inflationary expansion of the money supply, or various stages of development. In terms of descriptive and correlation-level relevance, digital infrastructure and AI readiness can be seen to have a visible relevance, with the direct impacts of these indicators on SME dynamism being less conspicuous when more sophisticated country and year controls are applied. This finding is incremental in the literature at global macro level: AI and digital transformation can, at the firm level, help SMEs with their performance, competitiveness and resilience; however, at the national level, SME dynamism is a result of a broader economic, institutional and capability setting.

6. CONCLUSION

This study examined the impact of digital infrastructure and AI readiness on SME dynamism across 153 countries during 2010–2022 using a complete-case panel dataset of 1,571 country-year observations. It was found that both dynamicity of SMEs and digital infrastructure advanced with the passage of time and digital infrastructure had a high positive correlation with dynamicity of SMEs. After country and year fixed effects were introduced however, the regression results were more cautious. Digital infrastructure was found to be positive and significant in the pooled OLS and country FE models, but no longer statistically significant in the more stringent 2W FE model. Likewise, there was no direct significant impact between

the AI readiness proxy and SME dynamism in the main and robustness models. These findings indicate that digital infrastructure and AI readiness can be enabling factors of SME activity; however, they alone do not seem to account for SME dynamism when taking into account a set of macroeconomic controls and country-specific effects. For this reason, the study provides a macro-level expansion of the SME digital transformation literature and demonstrates that business dynamism is not only driven by the digital and AI related capacities of the SME, but also by the economic, institutional and/or contextual conditions.

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